The Orientation of η Car
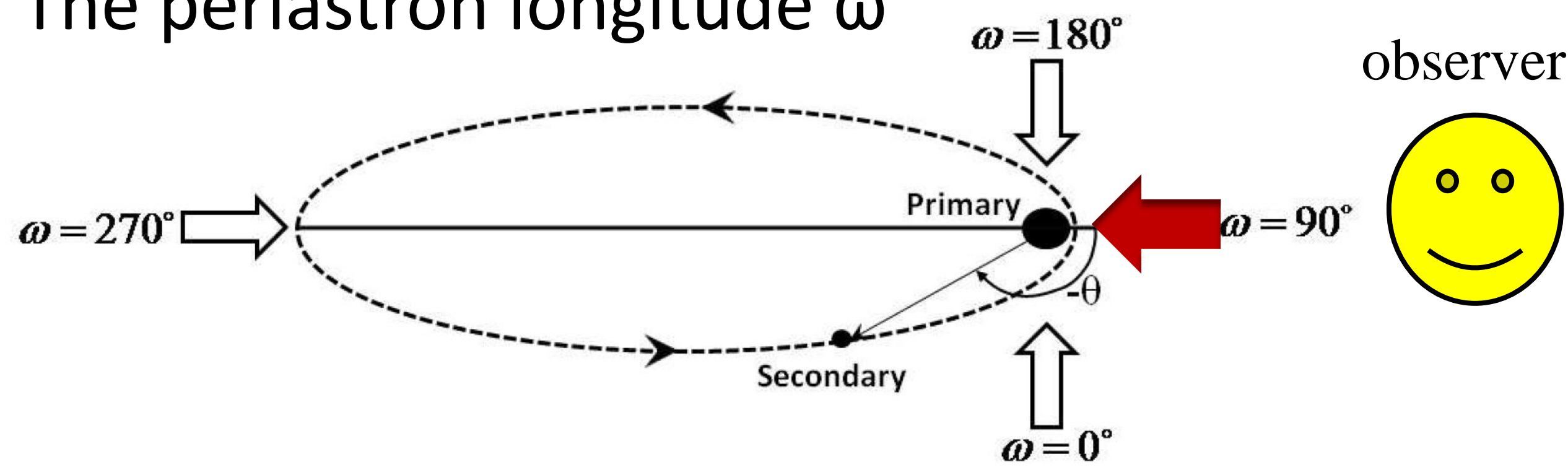
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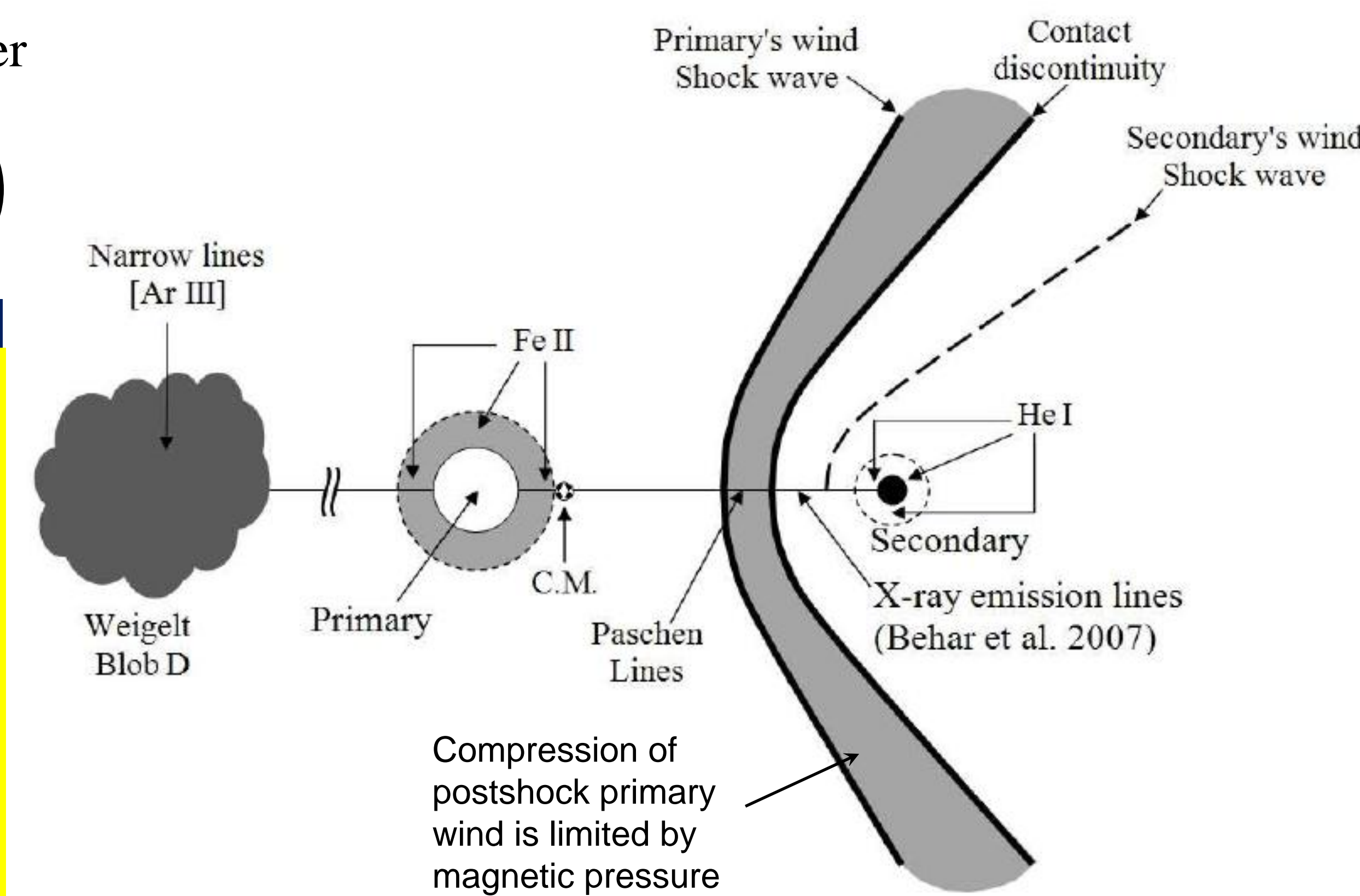
The periastron longitude ω
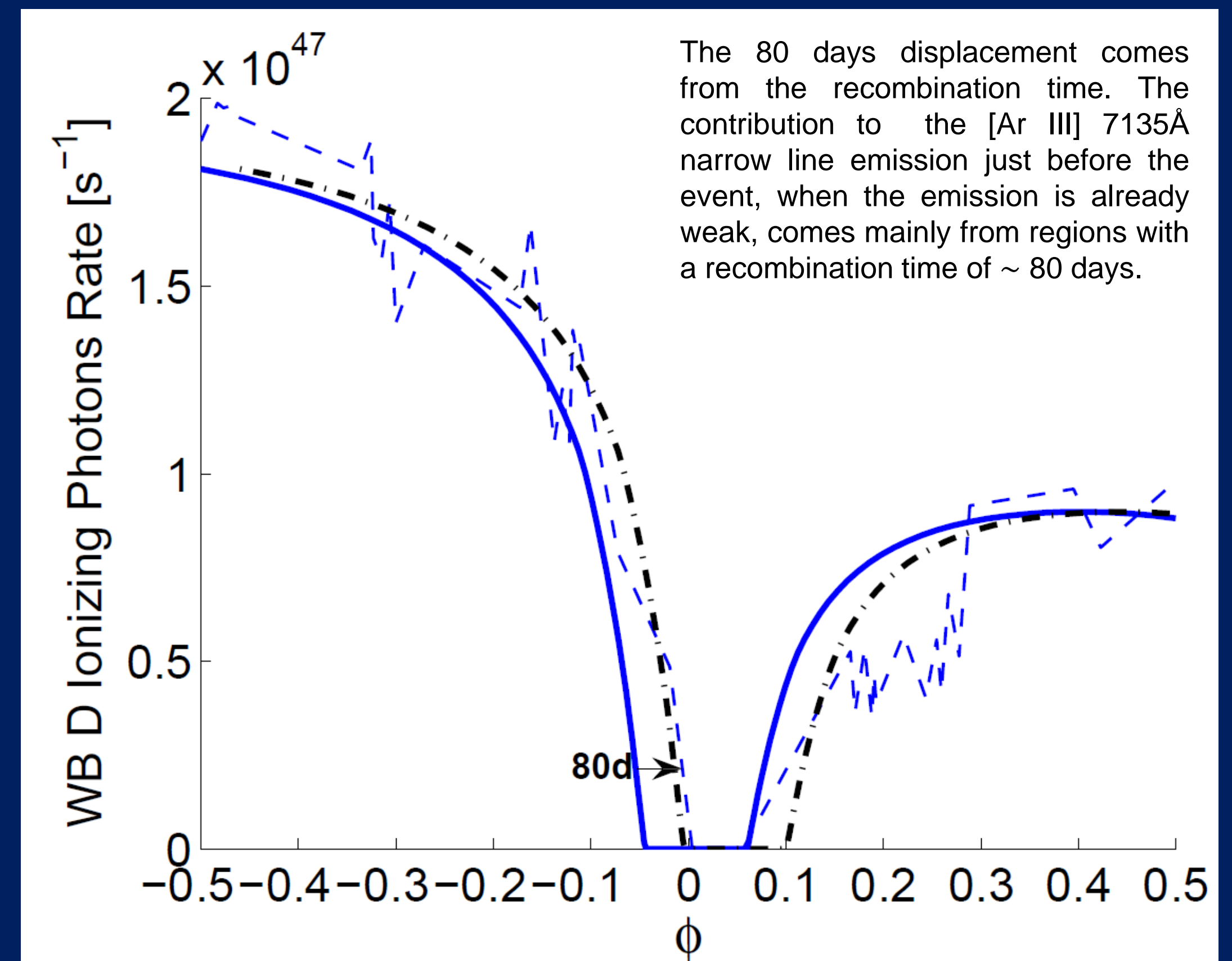

A schematic map of the system at **apastron**

Compression of postshock primary wind is limited by magnetic pressure

	ω=270°-300° primary towards the observer close to periastron	ω=90° secondary towards the observer close to periastron
Visible He I P-Cygni lines (λ7065, λ5876 and λ4471)	The source is the primary wind, and the variations are due to variations in ionization by the secondary (e.g., Nielsen et al. 2007).	The source is the acceleration zone of the secondary wind, where v_{zone}=430 km s^{-1}. Our model can reproduce the Doppler shift variations by attributing the shifts to the orbital motion of the secondary.
Fe II λ6455 line	No previous attempt to use this line to find the orbital orientation was done.	The source is the primary wind where v_{zone}=470 km s^{-1}. Doppler shifts can be fitted with the primary orbital motion when the observer is taken at ω=90°.
Paschen lines (Paγ, Paδ)	Damineli et al. (1997, 2000) and Davidson (1997) attributed the Doppler shifts of these lines to primary's orbital motion. We find that the amplitudes obtained in this case are too low.	We suggest that the source of these lines is the post-shocked primary wind, near the stagnation point of the colliding winds. We can fit the Doppler shifts of these lines if the observer is taken at ω=90°.
He I 10830Å	The He I 10830Å line was observed by Damineli et al. (2008). It is not clear what is the origin of the He I λ10830Å line if periastron longitude of ω=270°is considered. No quantitative model was suggested.	We suggest that the colliding winds region is responsible for the blue wing absorption of the He I 10830Å line. Only an observer at ω=90°can fit observations.
Weigelt Blobs' narrow lines (e.g. Ar [III] 7135Å)	The Weigelt blobs, located in the NW quadrant (towards the observer), and the weaker ionized structures are located in a region bounded by PAs from +38° to −82° in a clockwise direction. We see no narrow line emission in the complimentary region, what led several authors (e.g. Gull et al. 2009 and references therein), to suggest the maximum luminosity of the narrow lines is obtained when the conical shell is opened towards the Weigelt blobs, suggesting ω=270°.	The secondary UV radiation is absorbed by the conical shell and the primary wind. The dominant absorber is the primary wind which is much denser when the system approaches periastron. The secondary dives into the dense regions of the primary wind and its radiation is considerably absorbed. With this dependence we manage to explain the Ar [III] 7135Å narrow line emission from the blobs by taking an observer at ω=90° (see middle figure on the right).
Hydrogen column density toward hot X-ray emitting gas N_H (kT > 5 keV)"	Most of the binary orbit an observer at ω = 270° would observe the system through the secondary fast wind, which has negligible contribution to the column density. Using this viewing angle from behind the shock at apastron, it is impossible to account for the observed column density N_H = 17 × 10^{22} cm^{-2}, at phase 0.47 (Hamaguchi et al. 2007).	We manage to obtain the column density towards the hot gas as obtained from our model, (i,ω) = (42°,90°). We take into account the contribution of: The undisturbed (free-expanding) primary wind component. The post-shocked primary wind component. This component is not taken into account during accretion. The constant column density from the Homunculus and interstellar medium.
X-ray emission measure	Parkin et al. (2009) examined (i,ω) = (42°, 90°), and found the resulted flux at phase 0.98 to be ~5 times below the observed one. Parkin et al. (2009) assumed the emission measure (EM=$n_e n_p$V) to increase as EM ~ r^{-1}, where r is the orbital separation. However, the increase in the EM is smaller. Fitting the X-ray light curve with a simple model based on the intrinsic X-ray emission alone cannot teach us much about the orientation. Almost any inclination and periastron orientation can be fitted with some adjustment of the poorly known binary and wind parameters.	Any mode must fit separately both the emission measure and the hydrogen column density of the absorber. Our fitting of the column density is presented in the lower figure on the right. The emission measure does not increase as much as assumed by Parkin et al. (2009) . To explain the observed flux, the column density cannot increase by the large factor predicted by the ω= 270° periastron longitude. A shallower increase in the column density is reproduced by our preferred periastron longitude ω = 90°.

The 80 days displacement comes from the recombination time. The contribution to the [Ar III] 7135Å narrow line emission just before the event, when the emission is already weak, comes mainly from regions with a recombination time of ~ 80 days.

Our fit to the Weiglet Blobs B and D ionizing photons rate (thick solid line) and the normalized intensity of the [Ar III] 7135Å narrow dashed line (Damineli et al. 2008; thin dashed line).
The intensity of the line depends on the ionizing photons rate. In its way from the secondary to the blob, the secondary radiation suffers from absorption by: Post-shocked primary wind gas in the conical shell, and undisturbed primary wind which is the dominant absorber.
The absorption by the post-shock gas in the conical shell depends strongly on its density, which depends on (1) The compression balance between the ram pressure of the wind and the internal pressure of the post-shock gas. (2) magnetic field strength (3) geometry in the pre-shock primary's wind.
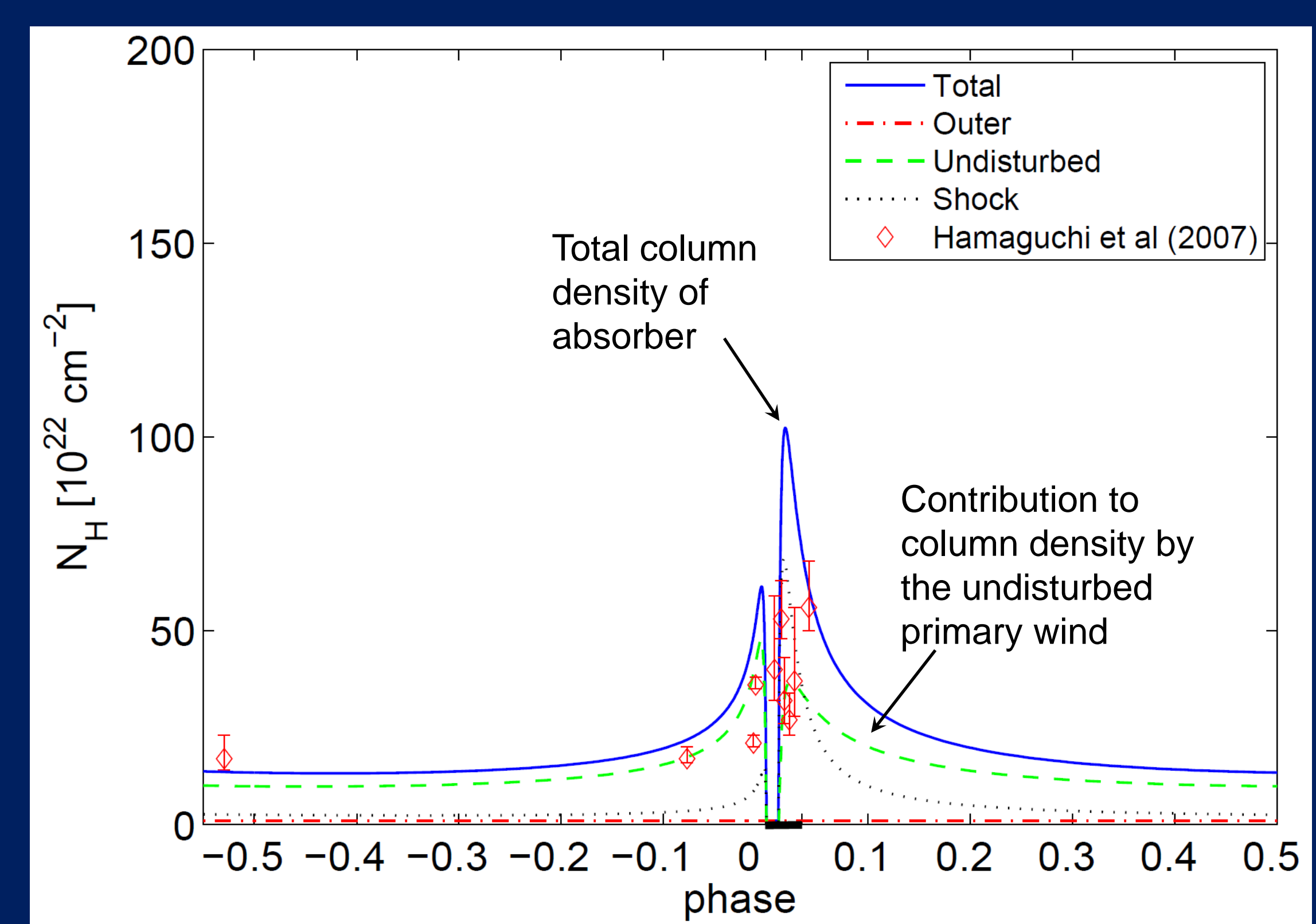
The column density toward the hot gas as obtained from our model, (i,ω) = (42°,90°). The dashed-green line represents the undisturbed (free-expanding) primary wind component ; the dottedblack line represents the post-shocked primary wind component; the dot-dashed red line represents the constant column density from the Homunculus and ISM. The solid-blue line is the sum of all three components. The N_H toward the hot gas from Hamaguchi et al. (2007) is plotted as red diamonds. The thick line on the horizontal axis mark the accretion period, during which the calculation of N_H is not applicable.